

Apprenticeship and Industry Training

Steamfitter-Pipefitter Apprenticeship Course Outline

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of Alberta** ■



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Course Outline

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Steamfitter-Pipefitter Provincial Apprenticeship Committee.

The graduate of the Steamfitter-Pipefitter apprenticeship program is a certified journeyperson who will be able to:

- install and maintain high pressure and low-pressure steam and hot liquid systems, including various process and industrial systems
- fabricate, join and install any pipe system used for various purposes in buildings, using any type of pipe including steel, alloy, cast iron, copper or plastic, etc.
- provide safe and efficient systems which function in conjunction with other systems
- comply with rules and codes governing installations
- read and interpret plans, specifications and working drawings and prepare layouts
- be proficient with the safe use of hand and power tools and equipment
- calculate material quantities and compile materials lists
- install components according to specifications and assume responsibility for the end product
- relate to job situations and other trades that precede or follow
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education and Technology on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
 - standards and requirements for training and certification in their trade
 - courses and examinations in their trade
 - apprenticeship and certification
 - designation of trades and occupations
 - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Steamfitter-Pipefitter PAC Members at the Time of Publication

Mr. L. Yakemchuk	Edmonton	Presiding Officer
Mr. K. Burge	Bonnyville	Employer
Mr. M. Clutterbuck	Edmonton	Employer
Mr. A. Nikitin	Edmonton	Employer
Mr. M. Grabil	Red Deer	Employee
Mr. R. Lloyd	Calgary	Employee
Mr. L. Adkins	Edmonton	Employee

Alberta Government

Alberta Advanced Education and Technology works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education and Technology to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act*.

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.gov.ab.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Addendum

As immediate implementation of the board's safety policy includes common safety learning outcomes and objectives for all course outlines, this trade's PAC will be inserting these safety outcomes into the main body of their course outline at a later date. In the meantime the addendum below immediately places the safety outcomes and their objectives into this course outline thereby enabling technical training providers to deliver the content of these safety outcomes.

STANDARD WORKPLACE SAFETY

A. Safety Legislation, Regulations & Industry Policy in the Trades

Outcome: *Describe legislation, regulations and practices intended to ensure a safe work place in this trade.*

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting

Outcome: *Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.*

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection.....

Outcome: *Describe the safety practices for hazardous materials and fire protection in this trade.*

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Steamfitter-Pipefitter apprenticeship technical training:

- Grande Prairie Regional College
- Medicine Hat College
- Northern Alberta Institute of Technology
- Keyano College
- Red Deer College
- Southern Alberta Institute of Technology
- Lakeland College
- Portage College

Procedures for Recommending Revisions to the Course Outline

Advanced Education and Technology has prepared this course outline in partnership with the Steamfitter-Pipefitter Provincial Apprenticeship Committee.

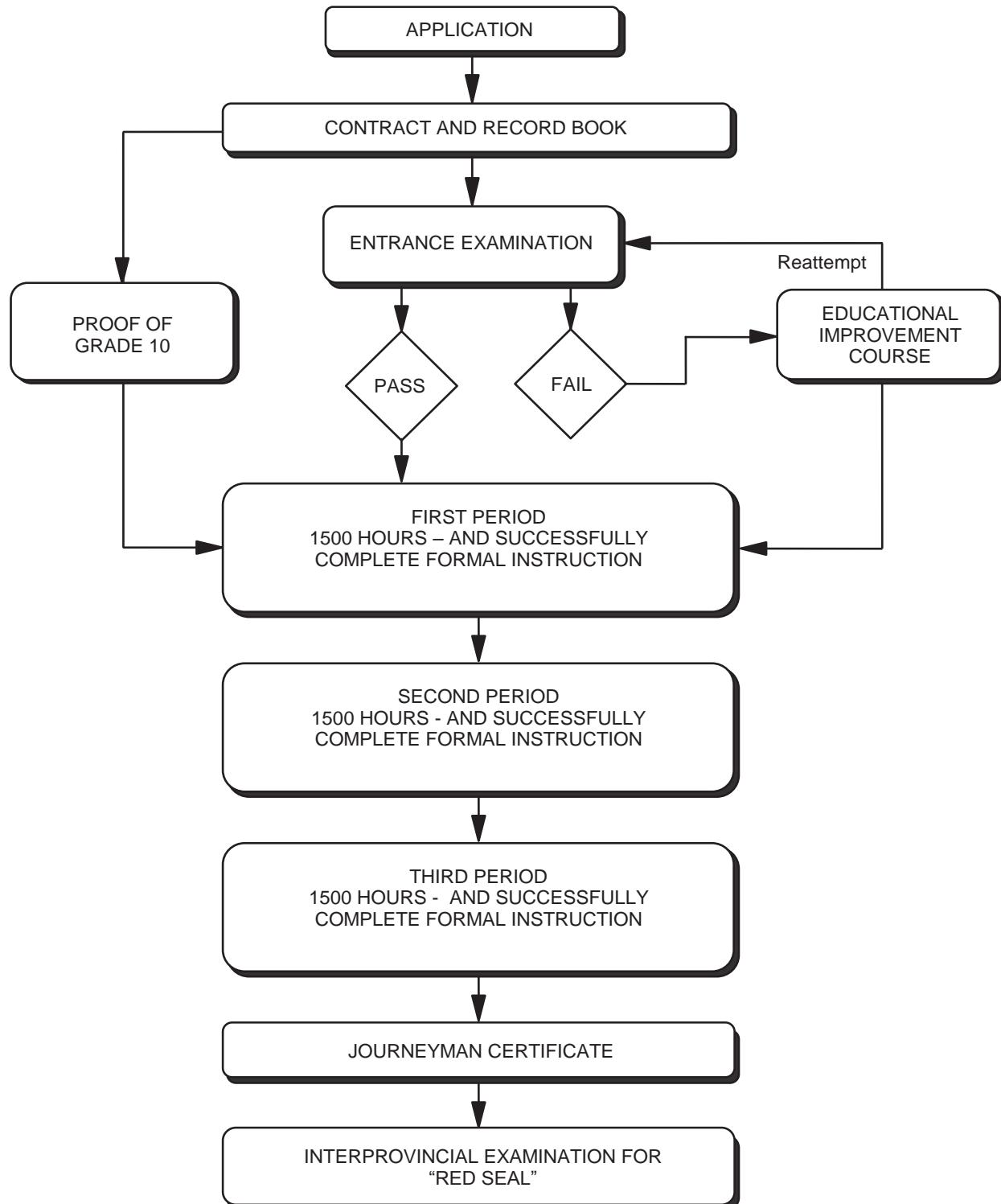
This course outline was approved on February 1, 2008 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

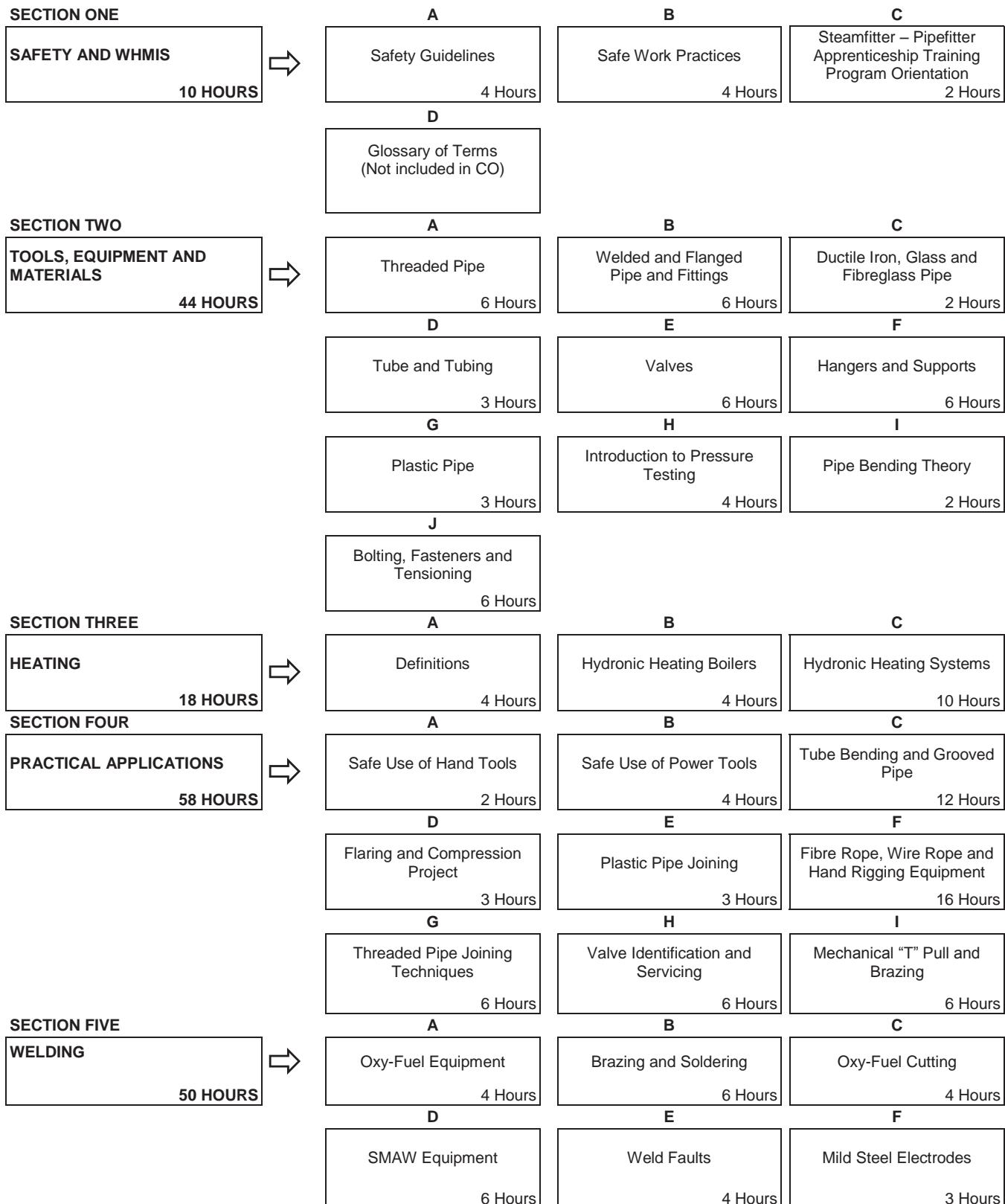
Steamfitter-Pipefitter Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education and Technology
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

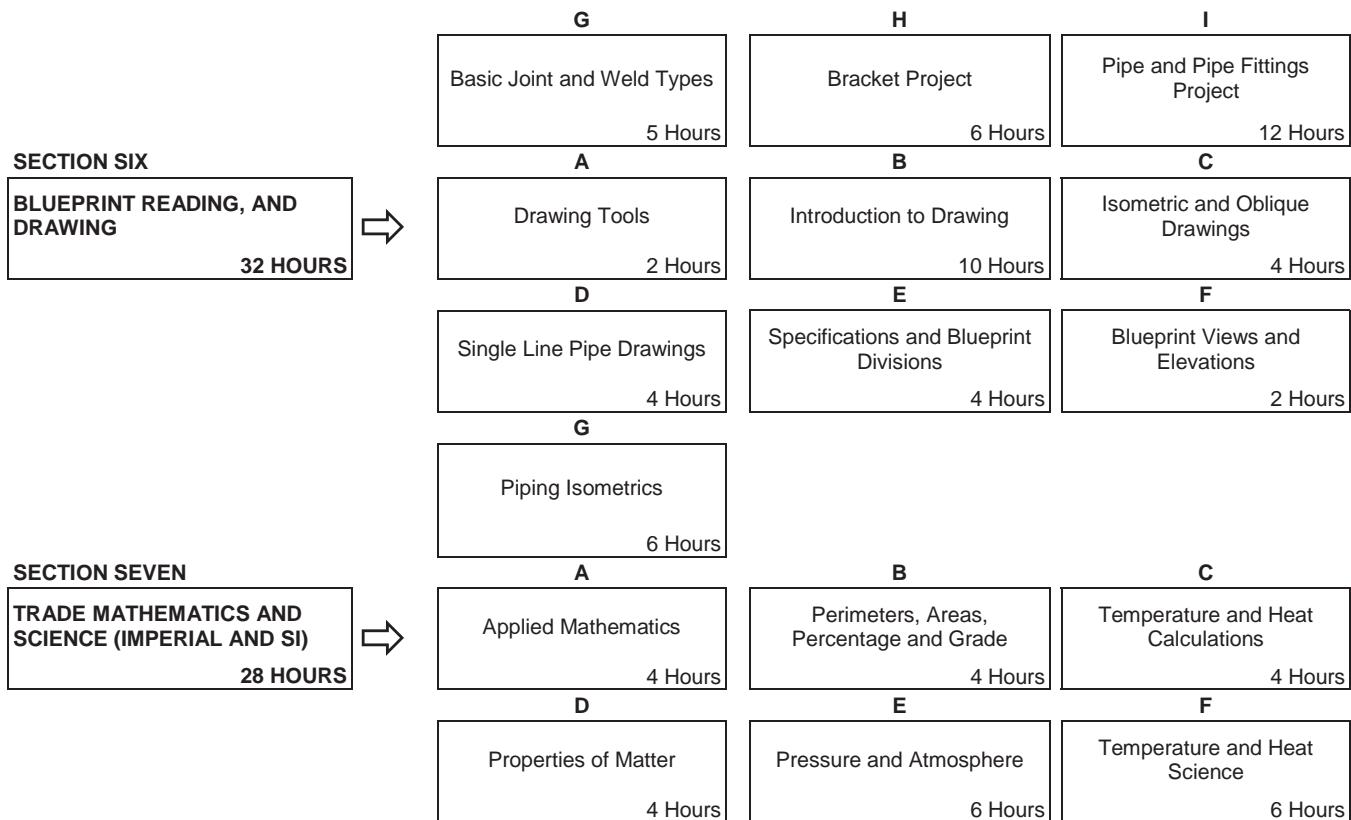
It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Steamfitter-Pipefitter Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification

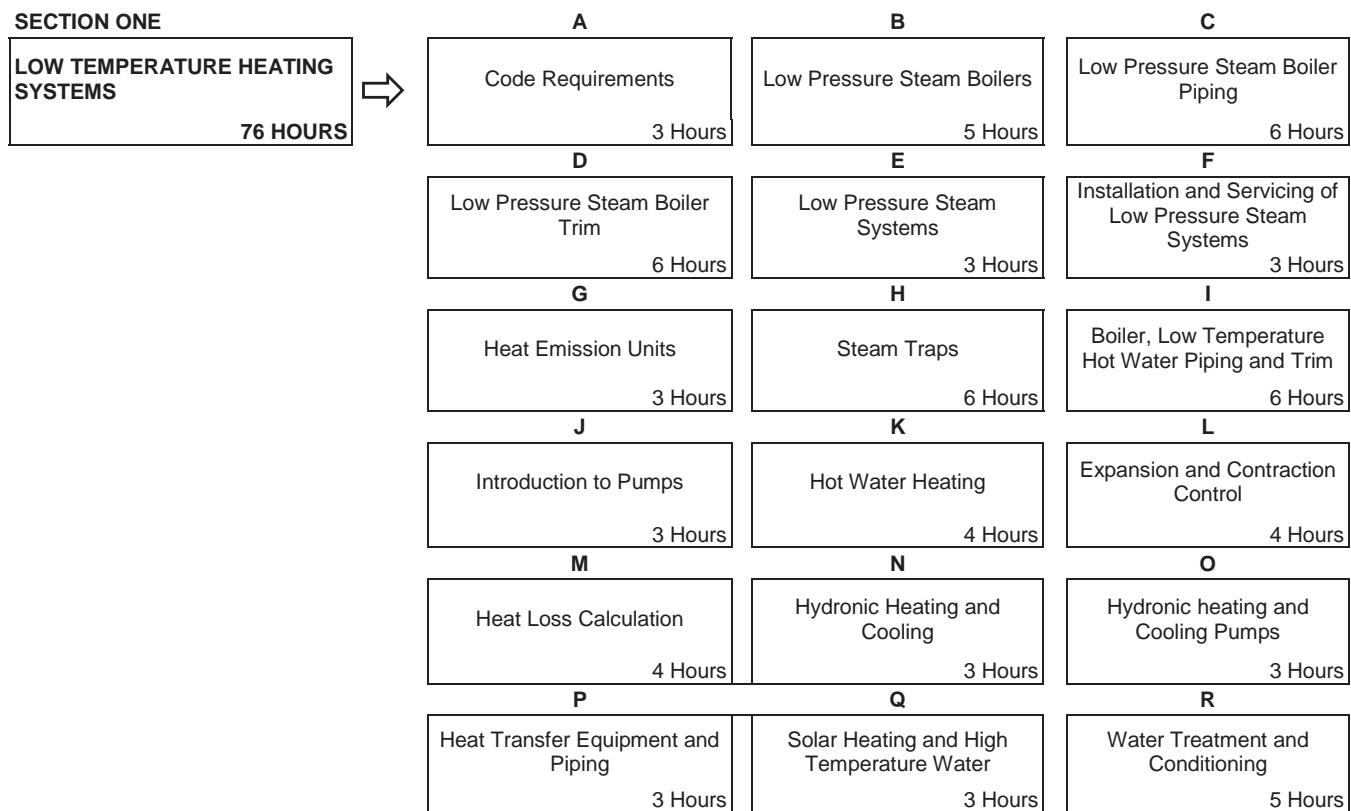


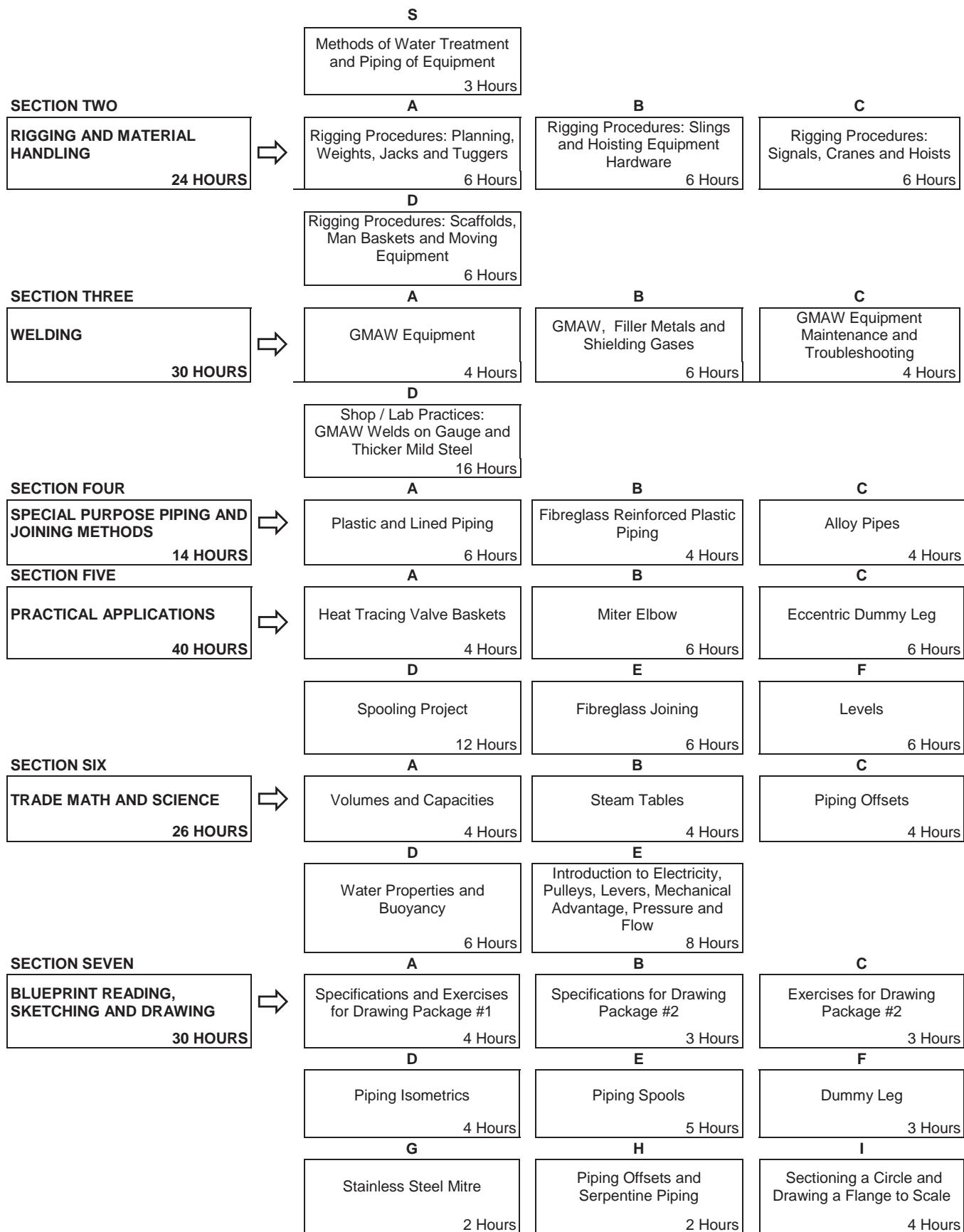
Steamfitter-Pipefitter Training Profile
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)



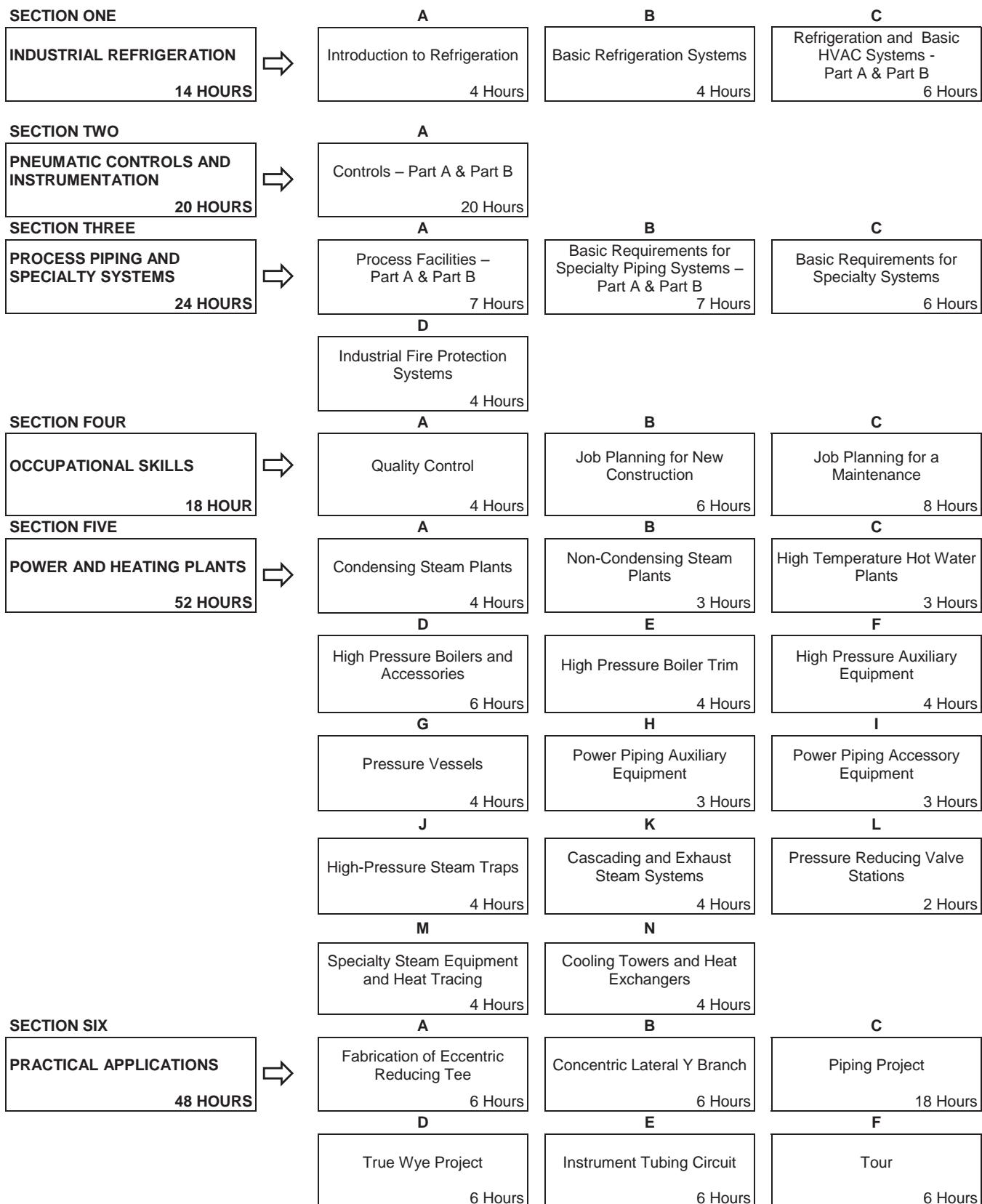


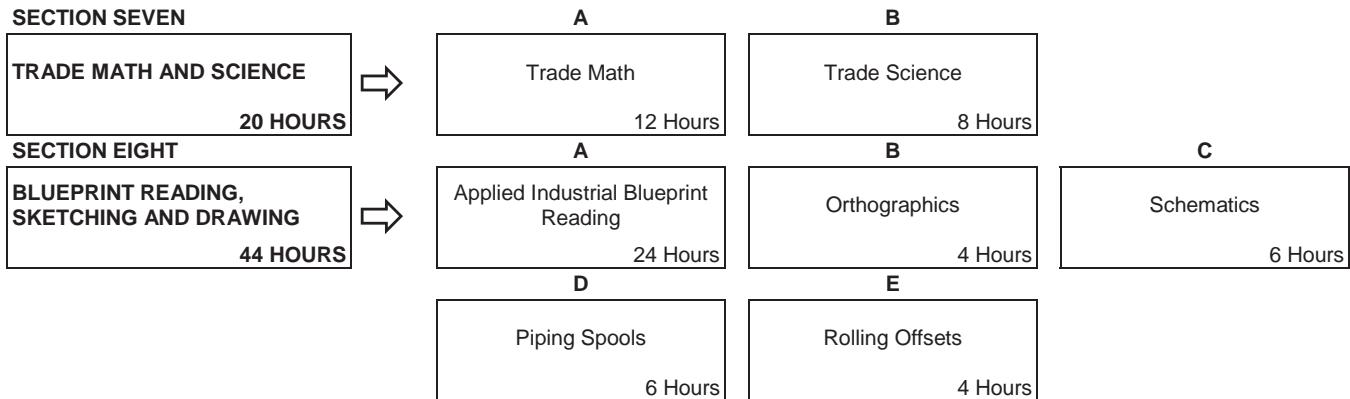
Second Period
(8 Weeks 30 Hours per Week- Total of 240 Hours)





Third Period
(8 Weeks 30 Hours per Week– Total of 240 Hours)





NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

**FIRST PERIOD TECHNICAL TRAINING
STEAMFITTER-PIPEFITTER TRADE
COURSE OUTLINE**

**UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO
PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.**

SECTION ONE:.....SAFETY AND WHMIS10 HOURS

A. Safety Guidelines.....4 Hours

Outcome: Apply WCB, O H & S and WHMIS guidelines to the Steamfitter-Pipefitter trade.

1. Describe applications of the Workers' Compensation Act in the workplace.
2. Demonstrate an ability to locate and interpret sections of the Workplace O H & S Act, Regulations and code as they apply to steamfitting – pipefitting.
3. Explain the WHMIS program.
4. Describe the procedure for entry and working in confined spaces or on potentially dangerous enclosures.

B. Safe Work Practices4 Hours

Outcome: Apply safe work practices and procedures when using welding or cutting equipment.

1. Identify physical hazards that are common to steamfitting, pipefitting, welding and cutting operations.
2. Identify the use of personal protective equipment for steamfitting, pipefitting and welding.
3. Identify fire hazards and methods of fire prevention.
4. Explain the hazards involved with welding fumes and gases.
5. Identify welding fume ventilation methods.
6. Identify personal protective equipment for hazardous and toxic materials.
7. Explain the effects of electricity and precautions used to prevent injury.

C. Steamfitter-Pipefitter Apprenticeship Training Program Orientation2 Hours

Outcome: Describe the responsibilities and opportunities in the Steamfitter – Pipefitter trade.

1. Describe the apprenticeship training system in Alberta.
2. Describe the scope of the Steamfitter – Pipefitter industry including historical foundations and career opportunities.
3. Interpret the Alberta Trade Regulations for the Steamfitter – Pipefitter trade.
4. Identify the training profile of the Steamfitter – Pipefitter Apprenticeship in Alberta.
5. Explain the Steamfitter – Pipefitter program outline learning outcomes and objectives.
6. Describe the responsibilities for the Contract of Apprenticeship by the apprentice, employer and Alberta Apprenticeship and Industry Training.
7. Identify industrial, commercial and construction fields that provide employment opportunities for steamfitter-pipefitters.
8. Discuss the contents of the apprenticeship training Record Book.

D. Glossary of Terms 0 Hours

Outcome: *Identify terms related to the Steamfitter–Pipefitter trade.*

1. Identify the terms for the Steamfitter–Pipefitter trade.

SECTION TWO:TOOLS EQUIPMENT AND MATERIALS 44 HOURS

A. Threaded Pipe 6 Hours

Outcome: *Fabricate, install and service ferrous pipe and fittings.*

1. Describe the composition of ferrous, alloyed and non-ferrous pipe.
2. Describe pressure ratings, schedule number, sizing and finishes pertaining to ferrous pipe.
3. Identify applications of codes, regulations and manufacturer's specifications pertaining to ferrous pipe.
4. Describe the proper procedures required to cut pipe using various hand and power tools.
5. Calculate cut length for threaded pipe.
6. Describe the fabrication process for threaded pipe.
7. Identify types, pressure ratings and symbols pertaining to pipe and fittings.
8. Interpret codes and regulations pertaining to pipe and fittings.

B. Welded and Flanged Pipe and Fittings 6 Hours

Outcome: *Fabricate, install and service welded pipe and fittings.*

1. Identify types, markings designations and pressure ratings and code interpretations welded pipe fittings.
2. Describe the fabrication process for welded pipe and fittings to the tack stage.
3. Identify types, markings, designations, temperature and pressure ratings and code interpretations of flanged fittings and gaskets.
4. Describe gasket preparation and joining techniques for flanged joints.

C. Ductile Iron, Glass and Fibreglass Pipe 2 Hours

Outcome: *Fabricate, install and service cast iron, fibreglass and glass piping.*

1. Identify approved grades, applications and code considerations for cast iron pipe and fittings.
2. Describe the fabrication process for cast iron piping.
3. Identify ductile iron water service pipe in regards to application, installation and code requirements.
4. Identify types, grades, applications, fabrication processes and code considerations for glass pipe and fittings.
5. Identify types, grades, applications, fabrication processes and code considerations for fibreglass pipe and fittings.

D. **Tube and Tubing** 3 Hours

Outcome: *Fabricate, install and service non-ferrous metal pipe and fittings.*

1. Identify types, colour code, designations and pressure ratings used for tube and tubing.
2. Identify fitting types, joining techniques and code interpretation used for tube and tubing.
3. Identify applications and codes, regulations and manufacturer's specifications pertaining to solder copper tube.
4. Identify application, code and health and safety issues pertaining to various common solders and fluxes.
5. Describe the fabrication process for soft soldered joints including tools and heating process.
6. Describe electric resistance soldering.

E. **Valves** 6 Hours

Outcome: *Install and service valves.*

1. Identify various styles and types of valves.
2. Describe major design variations and applications of various valves.
3. Identify common maintenance problems and service and maintenance procedures for valves.
4. Interpret codes, regulations and manufacturer's instructions pertaining to valves and installation.

F. **Hangers and Supports** 6 Hours

Outcome: *Support pipe and fittings above ground.*

1. Identify pipe, tube and tubing hangers used in the Steamfitter-Pipefitter trade.
2. Identify usage of hangers and their protective coatings.
3. Describe installation techniques for hangers.
4. Apply codes, specifications and manufacturer requirements for hangers.
5. Identify safety hazards for spring loaded or constant support hangers.

G. **Plastic Pipe** 3 Hours

Outcome: *Describe, install and service non-metallic pipe and fittings.*

1. Identify types, colour coding, applications and designations of plastic pipe and fittings.
2. Identify safety practices required for fabrication techniques.
3. Describe fabrication processes for solvent welding plastic pipe.
4. Describe fabrication processes for plastic pipe using mechanical joints.
5. Describe fabrication processes for bell end joints.
6. Describe fabrication processes for plastic pipe using thermal fusion and electric resistance welding.

H. Introduction to Pressure Testing 4 Hours

Outcome: *Identify pressure-testing methods used in the Steamfitter-Pipefitter trade.*

1. Identify equipment used for pressure testing piping installations.
2. Describe procedures for installing test equipment.
3. Describe QC (Quality Control) – QA (Quality Assurance) requirements and documentation for pressure testing.

I. Pipe Bending Theory 2 Hours

Outcome: *Describe methods of bending pipe.*

1. Identify materials and equipment used for pipe bending, including packing materials.
2. State features, procedures, limitations and safety hazards of various hot and cold bending procedures.

J. Bolting, Fasteners and Tensioning 6 Hours

Outcome: *Identify types of hangers, application and installation requirements.*

1. Describe fasteners used in the Steamfitter – Pipefitter trade.
2. Identify concrete anchors.
3. Identify stud tensioning systems.
4. State factors, methods and torque measurements for bolt torquing.

SECTION THREE: HEATING 18 HOURS

A. Definitions 4 Hours

Outcome: *Install and service hot water heating for a single family dwelling.*

1. Apply definitions pertaining to boilers.
2. Describe terminology pertaining to hot water and low pressure steam boiler trim.
3. Describe terminology pertaining to terminal heat units.
4. Describe principles of heat transfer.

B. Hydronic Heating Boilers 4 Hours

Outcome: *Identify hydronic heating boilers, ratings and trim.*

1. Describe boiler ratings and differences between low and high-pressure boilers.
2. Identify materials used to construct boilers.
3. Identify and describe the operation of various boilers.
4. List the advantages and disadvantages of various boilers.
5. Identify the parts and components of boiler trim and safety controls for a hot water boiler.
6. Describe the basic functions of boiler trim.
7. Locate and identify components and trim on a drawing or model.
8. Describe the trim on a low-pressure steam boiler and the differences between trim on the LP steam boiler and a hot water boiler.

C. Hydronic Heating Systems 10 Hours

Outcome: *Install and service hot water heating for a commercial building.*

1. Identify materials that are installed in hot water heating systems.
2. Describe layout and operation of various systems including advantages/disadvantages of each system.
3. Identify the component parts of piping systems.
4. Describe how air is eliminated from the system.
5. Identify locations and operation of air vents.
6. Describe the effects of convection and how water is circulated in a modern system.

SECTION FOUR: PRACTICAL APPLICATIONS 58 HOURS

A. Safe Use of Hand Tools..... 2 Hours

Outcome: *Use hand tools.*

1. Describe safety precautions when using hand tools.
2. Identify layout and measuring tools.
3. Identify clamping tools.
4. Identify cutting tools.
5. Identify the other hand tools used by Steamfitter-Pipefitters.

B. Safe Use of Power Tools..... 4 Hours

Outcome: *Use power tools.*

1. Demonstrate the safe operation of bench, pedestal, angle and straight grinders.
2. Demonstrate the use and safe operation of portable power drills, drill presses and twist drills.
3. Demonstrate the use and safe operation of metal forming, and shaping tools.
4. Identify the procedures for cutting metals using shearing machines, cut-off saws, and metal-cutting band saws.
5. Identify the operation and safe handling procedures when working with pneumatics.

C. Tube bending and Grooved Pipe 12 Hours

Outcome: *Install and service copper and iron pipe and fittings.*

1. Identify by name, size and material, the tools, pipe, tube and tubing used for bending purposes in the pipe trades.
2. Recognize grooved pipe, fittings and markings found on grooved fittings and identify blueprint symbols used for grooved joints.
3. Identify the pressure and temperature ratings including colour coding of gaskets and correct installation procedure for groove pipe and fittings.

D. Flaring and Compression Project 3 Hours

Outcome: *Perform flaring and compression joining.*

1. Identify by name, grade, size and state application of piping materials and fittings used for flared and compression joints in the pipe trades.
2. Using hand tools, prepare, assemble and test a flared spool to manufacturer's specifications and code requirements.
3. Using hand tools, prepare, assemble and test a compression spool to manufacturer's specifications and code requirements.

E. Plastic Pipe Joining 3 Hours

Outcome: *Prepare and assemble plastic pipe joints.*

1. Identify by name, grade, size and state application of plastic pipe and fittings used in pipe trades.
2. Using hand tools, prepare, assemble and test a PVC spool to manufacturer's specifications and code requirements.
3. Using hand tools, prepare, assemble and test a PE spool to manufacturer's specifications and code requirements.

F. Fibre Rope, Wire Rope and Hand Rigging Equipment 16 Hours

Outcome: *Describe types of rigging and hoisting materials and equipment.*

1. Describe the construction and selection of fibre rope and the purpose and use of knots.
2. Describe the construction and selection of wire rope.
3. Describe hand rigging equipment.
4. Describe harnesses and D-ring placement.

G. Threaded Pipe Joining Techniques 6 Hours

Outcome: *Perform threading techniques, complete and test the piping project to specific requirements.*

1. Identify tools used for threading pipe in pipe trades.
2. Use hand and power tools to thread pipe.
3. Demonstrate use of drophead dies, jam-proof ratchet threaders and power threaders.
4. Prepare a threaded pipe spool to required dimensions.
5. Hydraulic test threaded pipe project in accordance with the regulations and applicable codes.

H. Valve Identification and Servicing 6 Hours

Outcome: *Identify use and service of valves.*

1. Identify valves, parts and variations in design, including factors influencing valve selection.
2. Describe installation procedures and common service problems.
3. Use troubleshooting chart to determine the possible cause of the malfunction of a valve and describe how to adjust or repack a valve.
4. Interpret codes, regulations and manufacturer's instructions.

I. Mechanical "T" Pull and Brazing 6 Hours

Outcome: *Install and service copper and iron pipe and fittings.*

1. State approved applications and identify the equipment for mechanical T-pulled joints.
2. Describe the process for preparing a T-pulled mechanical joint.
3. State the approved application and identify the name, grade, size and materials, including flux, used for brazed and silver soldered joints in piping systems.
4. Identify the equipment pertaining to brazing and silver soldering, select the required tip and balance a torch.

SECTION FIVE: WELDING 50 HOURS

A. Oxy-Fuel Equipment 4 Hours

Outcome: *Assemble oxy-fuel equipment.*

1. Describe the characteristics and handling procedures for oxygen and fuel gases.
2. Describe the functions of oxy-fuel equipment components.
3. Describe the use, care and maintenance of oxy-fuel equipment components.
4. Explain the recommended procedure for placement, set-up and shutting down the equipment.
5. Identify causes and preventive measures for backfires, flashbacks and burn backs.
6. Describe pressure and flame adjustments.

B. Brazing and Soldering 6 Hours

Outcome: *Perform oxy-fuel welding, braze welding and brazing.*

1. Describe filler rods and fluxes.
2. Demonstrate the ability to run lines of fusion with and without filler rods in the flat and vertical positions.
3. Demonstrate the ability to weld lap joints on 10 Ga. or 11 Ga. (3.00-3.25 mm) mild steel in the horizontal (2F) and the vertical (3F) positions using a comparable filler material.
4. Demonstrate the ability to weld butt joints on 10 or 11 Ga. (3.00 - 3.25 mm) mild steel in the flat (1G) and vertical (3G) positions, using a comparable filler material.
5. Demonstrate the ability to weld lap joints on 10 Ga. or 11 Ga. (3.00 - 3.25 mm) mild steel in the vertical position using a braze welding filler material.

C. Oxy-fuel Cutting 4 Hours

Outcome: *Prepare a welded bracket.*

1. Demonstrate the ability to safely operate a hand-held oxy-fuel cutting torch on mild steel plate and structural shapes.
2. Perform straight line, bevel, and shape cutting on mild steel plate.
3. Pierce and cut holes in mild steel plate.
4. Cope 3/8" mild steel plate to fit a 4" channel member.
5. Demonstrate the ability to safely operate a machine oxy-fuel cutting torch on mild steel plate.

D. SMAW Equipment.....6 Hours***Outcome: Identify SMAW equipment.***

1. Define SMAW related terms.
2. Describe AC and AC-DC rectified welding power sources.
3. Describe AC-DC generator welding power sources.
4. Describe multi-process inverter welding power sources.
5. Identify welding cables and accessories for welding power sources.
6. Identify the effect of arc length on amperage and voltage.

E. Weld Faults.....4 Hours***Outcome: Identify the causes of faults in welds and methods for their prevention.***

1. Define the major classifications of weld faults.
2. Define notching effect.
3. Identify basic weld faults, their causes and ways to avoid them.

F. Mild Steel Electrodes.....3 Hours***Outcome: Select mild steel electrodes for SMAW.***

1. Identify and define the terms associated with SMAW electrodes.
2. Identify the CSA and AWS classification and specifications for SMAW electrodes.
3. Identify the types and functions of SMAW electrode coatings.
4. Describe the functions of the slag.
5. Describe basic care, handling and storage procedures for these electrodes.
6. Identify commonly used mild steel SMAW electrodes and their applications.

G. Basic Joints and Weld Types5 Hours***Outcome: Identify basic joints and weld types.***

1. Identify the five basic joints.
2. Describe the types of welds and their acceptable dimensions.
3. Identify joint and weld type variations.
4. Outline the major considerations to be accounted for in the design of a joint for welding.

H. Bracket Project.....6 Hours***Outcome: Fabricate a welded bracket.***

1. Interpret project drawing.
2. Select and prepare materials for bracket.
3. Tack and weld project as per specifications.
4. Verify accuracy of project.

I. Pipe and Fitting Project.....12 Hours

Outcome: *Fabricate a pipe spool.*

1. Interpret project drawing.
2. Select and prepare materials for spool.
3. Align and bridge tack project as per specifications.
4. Verify accuracy of project.

SECTION SIX:..... BLUEPRINT READING AND DRAWING..... 32 HOURS

A. Drawing Tools2 Hours

Outcome: *Perform basic geometric construction.*

1. Use T-squares, set squares, the compass, rulers and pencils.
2. Identify the parts of a circle.
3. Use a compass and straightedge to bisect lines, angles and arcs.
4. Use a compass and straightedge to construct a perpendicular line.
5. Construct a 90° and a 60° angle using a compass.
6. Divide a line into equal parts.
7. Divide a circle into equal parts.
8. Locate the centre of a circle.
9. Sketch a cover plate.
10. Develop patterns for various plate components.

B. Introduction to Drawing10 Hours

Outcome: *Identify lines, drawings and drawing equipment.*

1. Identify the alphabet of lines.
2. Describe the principles of scale drawings.
3. Identify perspective, oblique and isometric drawings.
4. Describe the principles of oblique and isometric drawings.
5. Describe the principles of orthographic projection.
6. Sketch simple objects in orthographic projection.
7. Identify metric and imperial dimensioning.
8. Describe size, location and notation dimensions.
9. Develop a fully dimensioned orthographic drawing to scale.

C. Isometric and Oblique Drawings.....4 Hours

Outcome: *Develop basic isometric and oblique drawings.*

1. Draw isometric and oblique drawings of basic rectangular objects.
2. Draw isometric and oblique drawings of basic objects with circular features.
3. Draw basic isometric forms.

D. Single Line Pipe Drawings.....4 Hours***Outcome: Draw and interpret both isometric and orthographic drawings.***

1. Describe the process for drawing orthographic views of 90° and 45° fittings and draw orthographic views.
2. Describe the process for drawing isometric single line piping arrangements and draw isometric single line piping spool with proper orientation.
3. Describe the process for lettering/labelling orthographic and isometric drawings.

E. Specifications and Blueprint Divisions4 Hours***Outcome: Read specifications and blueprints to complete the mechanical portion of a construction project.***

1. Define the five common divisions of a commercial/industrial blueprint.
2. Describe the purpose of blueprint divisions.
3. Identify and explain the Construction Specification Institute (CSI) format.
4. Read and interpret simple architectural and mechanical specifications.

F. Blueprint Views and Elevations2 Hours***Outcome: Locate and calculate elevations from a set of blueprints.***

1. From drawings and prints, recognize, interpret and explain view and drawings of a building floor, site and plot plans, elevations, sections and details.
2. From drawings and prints, recognize and interpret the following elevations: geodetic, modified geodetic and architectural.

G. Piping Isometrics6 Hours***Outcome: Draw single line piping isometrics using 90-degree elbows.***

1. Identify and draw common piping symbols.
2. Draw and label orthographic single line piping drawings and convert to isometric drawings.
3. Draw and label isometric single line piping drawings containing 90°elbows and tees.

SECTION SEVEN: TRADE MATHEMATICS AND SCIENCE (IMPERIAL AND SI)..... 28 HOURS**A. Applied Mathematics.....4 Hours*****Outcome: Implement basic mathematical skills relevant to the Steamfitter/Pipefitter trade, utilizing metric and imperial measurements.***

1. Describe the operation of a basic calculator.
2. Perform basic arithmetic calculations using whole numbers, fractions and decimals with the aid of a calculator.
3. Perform number conversions using whole numbers, fractions and decimals.
4. Perform measurement conversions using whole numbers, fractions and decimals.

B. Perimeters, Areas, Percentage and Grade 4 Hours**Outcome:** *Solve mathematical problems involving perimeter, areas, percentage and grade.*

1. Apply formulas for calculating perimeters of a rectangle, triangle and a circle.
2. Apply formulas for calculating areas of regular-shaped prisms.
3. Apply the formula for calculating percentages.
4. Calculate grades in both percentage and fraction per foot.

C. Temperature and Heat Calculations 4 Hours**Outcome:** *Implement basic heat calculations relevant to the Steamfitter-Pipefitter trade, utilizing both metric and imperial values.*

1. Perform temperatures conversion calculations.
2. State specific heat values of water and air.
3. Define latent heat and state the latent heat values of water, ice, and steam.
4. Calculate sensible and latent heat values.

D. Properties of Matter 4 Hours**Outcome:** *Define terminology related to matter and calculate densities and relative densities.*

1. Define matter, element, compound and mixture and identify the three states of matter.
2. Define adhesion, cohesion, surface tension and capillarity.
3. Define density and calculate density, mass and volume of substances.
4. Define relative density and calculate mass, volume and density of substances.

E. Pressure and the Atmosphere 6 Hours**Outcome:** *Utilize standard science fundamentals that are relevant to the Steamfitter-Pipefitter trade, applying both metric and imperial values.*

1. Define the terms pressure and force.
2. State the six principles of hydrostatic pressure.
3. State the pressure constants used for calculating pressures.
4. Perform pressure and force calculations in both imperial and metric units.
5. Describe atmospheric pressure and the effect of altitude.
6. Perform calculations to convert pressures from gauge to absolute.

F. Temperature and Heat Science 6 Hours**Outcome:** *Describe the heat transfer process as it applies to the Steamfitter-Pipefitter trade.*

1. Identify the three methods of heat transfer.
2. Explain the principles of expansion and contraction.
3. Perform calculations for linear expansion using coefficients of expansion tables.
4. Identify useful and detrimental effects of expansion and contraction.
5. Define terminology pertaining to the calculation of heat loss values.
6. Calculate a simple heat loss through a typical wall.

**SECOND PERIOD TECHNICAL TRAINING
STEAMFITTER-PIPEFITTER TRADE
COURSE OUTLINE**

**UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO
PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.**

SECTION ONE:.....LOW TEMPERATURE HEATING SYSTEMS76 HOURS

A. Code Requirements3 Hours

Outcome: Determine the differences between codes, standards, recommended practices and guides, and where each applies to the trade.

1. Describe the terms from ASME Sections IV and VI.
2. Describe and name other applicable codes.

B. Low-Pressure Steam Boilers5 Hours

Outcome: Recognize and describe the different types of boilers.

1. Describe how boilers are classified and rated.
2. Describe fire and water tube boilers and their components, including materials used in manufacture.
3. Describe the factors controlling the selection of boilers and their appropriate applications.
4. Describe proper installation techniques for low-pressure steam boilers, including code and manufacturer recommendations.
5. Describe low-pressure steam boiler problems and solutions.

C. Low-Pressure Steam Boiler Piping6 Hours

Outcome: State the application and requirements for installing low-pressure steam (LPS) boiler piping.

1. Describe piping components on a low-pressure steam boiler.
2. Describe the terms cross-connection, backflow and backsiphonage and the various methods of preventing cross-connection between a low-pressure steam boiler and a potable water supply.
3. Describe major categories of cross-connection control devices.
4. Describe the application of cross-connection control devices.
5. Describe the codes, regulations and requirements regarding the installation of cross-connection control devices.

D. Low-Pressure Steam Boiler Trim6 Hours

Outcome: State the requirements and application for associated trim.

1. Identify items of trim required for normal and safe operation of a low-pressure steam boiler.
2. List code requirements as to type, minimum and maximum sizes of low-pressure steam boiler trim.
3. Describe the application to which each item of low-pressure steam boiler trim is appropriate.
4. Describe common service problems along with their solutions for low-pressure steam boilers.

E. Low-Pressure Steam Systems 3 Hours***Outcome: Identify the different types of low-pressure steam systems.***

1. Identify characteristics of low-pressure steam systems.
2. Describe the variations of the low-pressure steam boiler piping needed for each system.
3. Identify basic layouts of low-pressure steam piping systems using ASHRAE recommendations.

F. Installation and Servicing of Low-Pressure Steam Systems 3 Hours***Outcome: Install and service low-pressure steam systems.***

1. Identify low-pressure steam system connection components.
2. Describe common problems associated with low-pressure steam systems and corrective actions.
3. Describe safety practices for installing and servicing low-pressure steam systems.

G. Heat Emission Units 3 Hours***Outcome: State the application and installation requirements for terminal heating units.***

1. Differentiate between high and low pressure steam and hot water, radiation, convection heat transfer units and forced air heat transfer units.
2. Identify various common heat transfer units and their required trim.
3. Identify methods of support, allowances for expansion and contraction, grading of heat transfer units and associated piping.
4. Identify maintenance requirements associated with hydronic heating systems.

H. Steam Traps 6 Hours***Outcome: Describe the operation and installation requirements for steam traps.***

1. Describe factors that determine the selection of a steam trap.
2. Describe the types and classifications of steam traps used on low-pressure steam systems.
3. Select a trap and determine the size based on pressure differential and capacity.
4. List and describe installation procedures, including the trim required for various traps.
5. List and describe minimum sizes and dimensions for a variety of drips and dirt pockets.
6. List and describe service problems along with corrective actions and methods of checking steam trap operations.

I. Boiler, Low-Temperature Hot Water Piping and Trim 6 Hours***Outcome: Install and service hot water heating boilers.***

1. Describe the types and uses of boilers found in small commercial and apartment applications.
2. State and list installation and testing procedures for boilers.
3. Describe and solve common service problems associated with boilers.
4. Describe and solve common service problems associated with systems.
5. List the trim components required for the operation of a hydronic heating system.
6. Identify the function of trim components required for the operation of a hydronic heating system.
7. Describe the function of each trim component as it is related to the overall operation of a hydronic heating system.

8. State, when, how and where a low water cut-off is installed and how it operates.

J. Introduction to Pumps 3 Hours

Outcome: *Describe styles of pumps, installation requirements and design factors for proper pump selection.*

1. Describe and compare differences in pumps.
2. Describe the factors that affect the suction head, including cavitation.
3. Describe and interpret factors that determine the size and type of pumps.
4. Describe procedures for installation, accessories, testing and replacing of pumps.

K. Hot Water Heating 4 Hours

Outcome: *Install and service hot water heating for a commercial installation.*

1. List and identify various materials that are installed in hot water heating systems.
2. Describe proper layout and operation of various systems including advantages and disadvantages of each system.
3. List and identify all component parts of various piping systems.
4. Describe how to eliminate air from the system.
5. Identify locations and operation of various air vents.
6. Describe the effects of convection and how water is circulated in a modern system.

L. Expansion and Contraction Control 6 Hours

Outcome: *Identify expansion control devices, calculate and apply appropriate expansion control methods.*

1. State the basic principles of expansion and contraction control, including methods for the use of anchors, guides, vent and drain locations.
2. Describe the methods to reduce friction between shoes and supports and to reduce or eliminate wearing of the pipe wall.
3. Describe the methods of anchoring and/or guiding thin-wall pipe and non-ferrous pipe.
4. State the factors for determining which expansion device to use for various piping systems, including locations of anchors, guides, expansion devices, vents and drains.
5. Describe procedures for correct installation and commissioning of expansion devices, including rule of thumb formulas for expansion loops and correct procedures for cold springing.
6. List and describe safety hazards and procedures relative to installing and servicing expansion devices and equipment.

M. Heat Loss Calculation 4 Hours

Outcome: *Recognize the design factors to complete a heat loss calculation and select the proper equipment for a particular application.*

1. Given heat loss for a total building, describe the procedure to calculate the heat loss for one room of a commercial building.
2. Describe methods used to select appropriate sized, heat transfer units, boiler, expansion tanks, pumps and piping.
3. Identify code requirements for hydronic heating systems.
4. Describe proper installation procedures of equipment and piping and develop a material list.

N. Hydronic Heating and Cooling 3 Hours

Outcome: *Describe the basic equipment installation requirements and operation of hydronic heating and cooling systems.*

1. Describe hydronic heating and cooling systems including the operation of common hydronic heating or heating and cooling piping systems.
2. Describe the equipment required for hydronic heating and cooling systems, including the operation of each, and the differences between hydronic heating, cooling and air conditioning.
3. Describe the operation, function, application and differences in various control valves.

O. Hydronic Heating and Cooling – Pumps 3 Hours

Outcome: *Describe the basic equipment installation requirements and operation of hydronic heating, cooling and water conditioning.*

1. List and describe pump principles, accessories required and interpretation of the manufacturer's information.
2. List and describe factors that determine the size and type of pump required.
3. List and describe installation procedures for pump, including consideration of mechanical seals, packing glands and seal water.
4. Size system piping, according to pump head and flow rate.
5. List and describe common service problems of hydronic heating and cooling systems.

P. Heat Transfer Equipment and Piping 3 Hours

Outcome: *Describe the basic equipment installation requirements and operation of heat transfer equipment and piping.*

1. Identify heat transfer equipment.
2. List and describe heat transfer equipment operation.
3. Sketch and identify heat transfer equipment piping arrangements.
4. Identify common heat transfer equipment service problems and their solutions.

Q. Solar Heating and High Temperature Water Systems 3 Hours

Outcome: *Describe the basic equipment installation requirements and operation of solar and high temperature hot water systems.*

1. Identify solar heating systems and basic installation procedures.
2. Identify basic high temperature hot water (HTHW) systems along with ASME code requirements.
3. Identify common service problems associated with HTHW systems.

R. Water Treatment and Conditioning 5 Hours

Outcome: *State requirements for basic installation and operation of water treatment and conditioning equipment.*

1. Identify classes of water supply and the impurities found in them.
2. Identify definitions pertaining to water treatment and conditioning.
3. Identify the differences between temporary, permanent, total hardness and total dissolved solids.
4. Describe the methods of measuring and the ranges associated with hardness.

5. List and describe the origins of other impurities found in water and the processes required to remove or neutralize them.
6. Identify problems and their solutions associated with piping and related equipment regarding water treatment and conditioning.

S. Methods of Water Treatment and Piping of Equipment.....3 Hours

Outcome: *State the requirements for the basic installation and operation of water treatment and conditioning equipment for commercial, institutional and industrial applications.*

1. Identify water treatment processes and the differences in equipment associated with condensing, non-condensing and HTHW plants.
2. List and describe installation and piping procedures for water treatment and conditioning in regard to safety, code and manufacturer's instructions.
3. Identify problems with their solutions associated with water treatment and conditioning piping and equipment.

SECTION TWO:..... RIGGING AND MATERIAL HANDLING 24 HOURS

A. Rigging Procedures: Planning, Weights, Jacks and Tuggers6 Hours

Outcome: *Describe types of rigging and hoisting materials and equipment.*

1. Identify and describe rigging procedures.
2. Estimate the weight of various objects when given the size, shape and material.
3. Describe hand-rigging equipment.

B. Rigging Procedures: Slings and Hoisting Equipment Hardware6 Hours

Outcome: *Describe types of rigging and hoisting materials and equipment.*

1. Describe the construction and use of chain and chain slings.
2. Describe the construction and use of steel and fibre slings.
3. Describe hoisting equipment hardware.

C. Rigging Procedures: Signals, Cranes and Hoists.....6 Hours

Outcome: *Apply materials handling and rigging procedures.*

1. Describe standard hand signals used for rigging and hoisting operations.
2. Describe types of mobile cranes.
3. Describe the set-up and safety procedures for mobile cranes.
4. Describe electric overhead travelling cranes.

D. Rigging Procedures: Scaffolds, Man Baskets and Moving Equipment6 Hours

Outcome: *Apply materials handling with regards to scaffolds, platforms and man baskets.*

1. Describe safe procedures for lifting and moving loads without a hoist.
2. Describe different types of scaffolds, platforms and man baskets.
3. Describe erection procedures for different types of scaffolds, platforms and man baskets.
4. Describe regulations for different types of scaffolds, platforms and man baskets.

5. Describe safe work practices when rigging or working with scaffolds, platforms and man baskets.

SECTION THREE:WELDING30 HOURS

A. Introduction to GMAW Equipment4 Hours

Outcome: Select GMAW equipment.

1. Describe the principles of operation of the GMAW.
2. Identify the components of a basic GMAW set-up.
3. Describe the modes of metal transfer obtained with the GMAW.
4. Describe GMAW power sources and wire feeders.
5. Describe GMAW wire drive systems and gun and cable assemblies.
6. Identify shielding gas supply systems for GMAW.

B. GMAW Filler Metals, Shielding Gas and Safety6 Hours

Outcome: Select GMAW consumables and apply safe work practices.

1. Identify GMAW consumables and apply safe work practices.
2. Identify shielding gases for GMAW.
3. Identify advantages and disadvantages of GMAW.
4. Identify the precautions you must take against electric shock, toxic fumes and radiant energy associated with GMAW.

C. GMAW Equipment Maintenance and Troubleshooting4 Hours

Outcome: Set-up, maintain and troubleshoot GMAW equipment.

1. Describe and demonstrate the set-up and maintenance required for wire drive systems and gun assemblies.
2. Diagnose and demonstrate corrective measures for malfunctioning GMAW equipment.

D. Shop / Lab Practices: GMAW Welds on Gauge and Thicker Mild Steel16 Hours

Outcome: Perform Surface welds in the flat and horizontal positions.

1. Demonstrate the ability to weld 1F welds on mild steel plate.
2. Demonstrate the ability to weld fillet welds in the horizontal (2F) position on mild steel plate.
3. Demonstrate the ability to weld fillet welds in the vertical (3F) position (downhill root and uphill fill and cover pass) on mild steel plate.
4. Prepare and fit up butt joints without backing.
5. Demonstrate the knowledge to weld fillet welds in the horizontal (2F) position on mild steel plate.
6. Demonstrate the knowledge to weld fillet welds in the vertical (3F) position on mild steel plate.

SECTION FOUR:SPECIAL PURPOSE PIPING AND JOINING METHODS..... 14 HOURS**A. Plastic and Lined Piping6 Hours*****Outcome: State the installation requirements of special purpose plastic and lined piping.***

1. List and identify names, colour codes and classifications of plastic piping.
2. State criteria used to select specific plastic piping for specific purposes and joining methods.
3. State support recommendations, including code requirements.
4. Identify the materials commonly used as liners in piping systems, including code.
5. State the criteria for the selection of specific liners and joining methods used for lined pipe.
6. State the requirements for supporting lined pipe, including safe work practices to be followed when installing lined pipe.

B. Fibreglass Reinforced Plastic Piping4 Hours***Outcome: State the installation requirements of fiberglass piping.***

1. List and describe the construction, the plastics used and the materials that form fibreglass reinforced (FRP) pipe.
2. State the purpose of additives used in resin.
3. State the criteria for selecting FRP pipe over other piping, including applications and joining methods.
4. Describe safe handling and WHMIS requirements for the installation of FRP piping.

C. Alloy Piping4 Hours***Outcome: State installation requirements of alloy pipes.***

1. Differentiate between ferrous and non-ferrous alloys, listing the more common elements and the properties each possess and why they were selected for a particular alloy.
2. State code references and manufacturer's recommendations for installation and support of the variety of sizes and alloy pipe available.
3. List and describe joining procedures, including gasket and stud requirements, special end preparations and required stress relieving procedures.
4. State correct safe work practices to follow when joining and installing alloy piping.

SECTION FIVE:PRACTICAL APPLICATIONS 40 HOURS**A. Heat Tracing Valve Baskets4 Hours*****Outcome: Complete heat tracing project to specific instructions and dimensions.***

1. List various types and grades of tube or tubing used for heat tracing.
2. Identify symbols used on spool and other drawings for heat tracing.
3. Complete valve basket bending following instructions.

B. Miter Elbow 6 Hours***Outcome: Complete a miter elbow project to specific instructions and dimensions.***

1. Identify symbols used on spool sheets and other piping drawings, including pipe type, size and grade.
2. State the procedures to follow to calculate cutback, mark a pipe for cutting and check for square after the cut is complete and list tool requirements.

C. Eccentric Dummy Leg 6 Hours***Outcome: Complete an eccentric dummy leg project to specific instructions and dimensions.***

1. Using Ordinates for 1000 Pipe Intersections book by S.D. Bowman, calculate minimum length of dummy leg.
2. Identify required tools.

D. Spooling Project 12 Hours***Outcome: Complete a piping spool project to specific instructions and dimensions.*****E. Fibreglass Joining 6 Hours*****Outcome: Complete a fibreglass joining project to specific instructions and dimensions.*****F. Levels 6 Hours*****Outcome: Use a builder's level and complete a survey sheet.***

1. Identify various types of builder's levels and list and describe terminology associated with the use of builders levels.
2. Describe the use of builder's levels to determine prescribed elevations.

SECTION SIX: TRADE MATH AND SCIENCE 26 HOURS**A. Volumes and Capacities 4 Hours*****Outcome: Calculate volumes and capacities of tanks and cylinders.***

1. State the formulas for calculating volumes and capacities of regular shaped solids, tanks and cylinders.
2. Calculate capacity of regular shaped tanks and cylinders using both metric and imperial values.

B. Steam Tables 4 Hours***Outcome: Define terms, interpret and apply steam tables.***

1. Explain the application and usage of the steam tables.
2. Define terms associated with the use of the steam tables.
3. State the effects of pressure, vacuum and volume of steam.
4. Identify the latent heat of vaporization of water at various boiling temperatures above or below atmospheric pressure.

C. Piping Offsets.....4 Hours***Outcome: Calculate offsets for piping systems.***

1. Calculate offsets using the Pythagorean Theorem.
2. State and employ formulas for 22.5° and 45° offsets.
3. Describe the application of single and single offset around corners.
4. Calculate fitting allowances and cut lengths of pipe and tube in both imperial and metric.

D. Water Properties and Buoyancy6 Hours***Outcome: Define properties of water, apply and calculate buoyancy and basic heat loss.***

1. Describe the chemical properties of water and the effect of temperature in hot water systems.

State the three laws of buoyancy and describe the effect of buoyancy on regular shaped objects submersed in water.

E. Introduction to Electricity, Pulleys, Levers, Mechanical Advantage, Pressure and Flow.....8 Hours***Outcome: Use standard fundamentals of electricity and pressure and flow calculations.***

1. Identify basic principles of electricity including direct and alternating current flow, electrolysis and electromagnetism.
2. Sketch simple electrical circuits, and the calculation of Ohm's Law.
3. Describe pulleys, classifications of levers and mechanical advantage.
4. State the application of pulleys and levers including the demonstration of mechanical advantage.
5. List and describe the terminology pertaining to the flow of water in a piping system.
6. List and describe the operation of a venturi and the cause, effects and prevention of cavitation.
7. State formulas for solving simple head pressure calculations.
8. Describe the principles of Boyle's Law on behaviour of perfect gases.
9. Describe the principles of Charles' Law on behaviour of perfect gases.
10. Calculate simple problems using Boyle's and Charles' Law.

SECTION SEVEN: BLUEPRINT READING SKETCHING AND DRAWING 30 HOURS**A. Specification and Exercises for Drawing Package #14 Hours*****Outcome: Interpret blueprints for commercial and industrial projects.***

1. Interpret blueprints in both SI and imperial units for small commercial and small mechanical.
2. Identify steamfitting–pipefitting equipment to be installed.
3. Identify correct location and sizes of equipment to be installed.
4. Analyse blueprints for possible service conflicts.
5. Read and interpret blueprints for sectional drawings.
6. Read and interpret blueprints for detail drawings.
7. Locate grades, centre-line and elevations on blueprints.
8. Locate inserts and sleeve on blueprints.
9. Read and interpret blueprint legends.

B. Specifications for Drawing Package #2 3 Hours***Outcome; Correctly interpret blueprints for small commercial and industrial projects.***

1. Read and interpret specifications for a commercial/industrial projects.

C. Exercises for Drawing Package #2 3 Hours***Outcome; Correctly interpret blueprints for small commercial and industrial projects.***

1. Review blueprints identifying piping and equipment to be installed
2. Identify and interpret basic symbols.
3. Identify, read and interpret drawings for piping and equipment types, sizes and locations.
4. Review blueprints for service conflicts.
5. Identify, read and interpret section drawings, including elevation drawings.
6. Identify, read and interpret flow sheets.
7. Identify, read and interpret specifications for a commercial/industrial project.

D. Piping Isometric 4 Hours***Outcome: Draw isometric piping spools to specific requirements.***

1. Define terms used in isometric drawings.
2. Draw isometrics using isometric layout.
3. Draw isometrics with horizontal and vertical offsets.
4. Draw isometric piping with horizontal and vertical offsets.

E. Piping Spools 5 Hours***Outcome: Draw piping spools to specific requirements.***

1. Define piping spools.
2. Define terms used for piping spools.
3. Identify fitting symbols.
4. Draw and orientate piping spools.
5. Draw piping spools for specific shop projects.
6. Provide material lists with numbering on piping spools.

F. Dummy Leg 3 Hours***Outcome: Sketch and label a dummy leg to specific requirements.***

1. Identify the use and application of a dummy leg.
2. Sketch and label a dummy leg project to specifications.

G. Stainless Steel Mitre 2 Hours***Outcome: Calculate odd angles with the use of trigonometry.***

1. Use trigonometry to sole right angle triangle problems.
2. Use trigonometry to solve cut angle and cutback for mitered fittings.

H. Piping Offsets and Serpentine Piping 2 Hours

Outcome: *Solve equal and unequal spread offsets and calculate the length of tubing required for in-slab heating.*

1. List and describe applications and calculations for equal and unequal spread offsets.
2. List and describe applications and calculations for serpentine piping.

I. Sectioning a Circle and Drawing a Flange to Scale 4 Hours

Outcome: *Use geometry to divide a circle into equal parts and to lay out a flange pattern.*

1. List and describe geometric terms associated with the bisecting lines, creating angles and dividing a circle into equal parts.
2. Describe and draw a piping flange to scale.

**THIRD PERIOD TECHNICAL TRAINING
STEAMFITTER-PIPEFITTER TRADE
COURSE OUTLINE**

**UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO
PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.**

SECTION ONE:.....INDUSTRIAL REFRIGERATION14 HOURS

A. Introduction to Refrigeration4 Hours

Outcome: Describe basic refrigeration terms and materials.

1. State factors pertaining to refrigeration and air conditioning that effect comfort and health.
2. State terms associated with refrigeration.
3. Describe materials and fittings used on refrigeration systems.
4. Describe tools and gauges required to install and service refrigeration systems.

B. Basic Refrigeration Systems4 Hours

Outcome: Describe basic refrigeration operation, refrigerants and components.

1. Describe the basic refrigeration cycles.
2. State the properties of suitable refrigerants.
3. Describe refrigeration compressors, evaporators and related equipment.

C. Refrigeration and Basic HVAC Systems – Part A & Part B6 Hours

Outcome: Describe refrigeration flow control and HVAC systems.

1. Identify the five general types of mechanical refrigeration systems based upon flow control devices.
2. Identify hydronic heating and cooling piping arrangements.
3. Identify and state the principles of air conditioning.
4. Identify HVAC piping and applications.
5. Identify HVAC safety procedures and summarize air conditioning.
6. Define a heat pump according to the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and describe the installation procedures.

SECTION TWO:.....PNEUMATIC CONTROLS AND INSTRUMENTATION.....20 HOURS

A. Controls – Part A & Part B20 Hours

Outcome: State applications and common types of controls.

1. Describe the terms relative to control systems, including open loop, closed loop and cascade controls.
2. Describe the purpose and function of operators and final control elements.
3. Describe the purpose and function of pneumatic controllers.
4. Describe the purpose and function of auxiliary devices found on control systems.
5. Describe the purpose and function of the primary elements of controls and instrumentation.

6. Describe the components of an air supply for a pneumatic control system.
7. Describe the installation procedures for controls, control systems, piping and supports.
8. Describe safe work practices used when installing controls and control systems.

SECTION THREE:PROCESS PIPING AND SPECIALTY SYSTEMS..... 24 HOURS

A. Process Facilities – Part A & Part B..... 7 Hours

Outcome: State processes and specialty piping requirements for major plants.

1. Using blueprints and flow sheets identify the major components for the basic processes encountered in pulp mills, paper mills, oil refineries and gas plants.
2. Describe the reasons for use of specialty piping installed in pulp mills, paper mills, oil refineries and gas plants.
3. State safety hazards associated with the processes encountered in pulp mills, paper mills, oil refineries and gas plants.
4. Using blueprints and flow sheets identify the major components for the basic processes encountered in caustic chemical plants, condensing power plants, breweries, dairies and nuclear plants.
5. Describe the reasons for use of specialty piping installed in pulp mills, caustic chemical plants, condensing power plants, breweries, dairies and nuclear plants.
6. State safety hazards associated with the processes encountered in caustic chemical plants, condensing power plants, breweries, dairies and nuclear plants.

B. Basic Requirements of Specialty Piping Systems – Part A & Part B 7 Hours

Outcome: List and describe the basic requirements for specialty piping systems.

1. Describe specialty piping systems.
2. Identify symbols and terminology associated with specialty piping systems.
3. Identify specialty systems piping materials and joining methods.
4. State the reasons for the use of special purpose piping.
5. Describe special procedures required when installing specialty systems.
6. Describe maintenance requirements of specialty systems.

C. Basic Requirements of Specialty Systems 6 Hours

Outcome: Describe the basic requirements for specialty piping systems.

1. Identify and describe specialty systems.
2. Identify symbols and terminology associated with specialty systems.
3. Identify specialty systems piping materials and joining procedures.
4. State reasons for the use of special piping.
5. Describe special procedures required when working with specialty piping systems.
6. Describe maintenance requirements of specialty systems.

D. Industrial Fire Protection Systems 4 Hours

Outcome: *State the application and installation requirements for various industrial fire protection systems.*

1. List and describe various industrial fire protection systems.
2. List and describe applications and special features of various fire protection systems.
3. State National Fire Protection Act (NFPA) requirements.
4. List and describe safe work practices for fire protection systems.

SECTION FOUR: OCCUPATIONAL SKILLS 18 HOURS

A. Quality Control 4 Hours

Outcome: *State basic requirements and applications of quality control manuals.*

1. Describe the applications of quality control manuals.
2. Describe the scope and applications of quality control manuals.
3. Describe jobsite application of quality control manuals.

B. Job Planning for New Construction 6 Hours

Outcome: *Describe the organization of materials, labour and equipment for a new construction project.*

1. Identify material requirements.
2. Identify labour requirements.
3. Describe sequencing of trades for a new construction project.
4. Identify equipment required to perform required tasks.
5. Identify test requirements including inspection test plans (ITP).
6. Describe documentation required upon completion of project.

C. Job Planning for a Maintenance Project 8 Hours

Outcome: *Describe the organization of materials, labor and equipment for a maintenance project.*

1. Identify material and labour requirements.
2. Identify equipment required to perform required tasks.
3. Identify sequence of shutdown and lockout procedures.
4. Identify procedures for draining and purging of lines.
5. Describe procedures for removal of lockouts and blinds.
6. Identify test and inspection requirements.
7. Describe ready for operation procedure (RFO).

SECTION FIVE:POWER AND HEATING PLANTS52 HOURS**A. Condensing Steam Plants4 Hours**

Outcome: Describe the operation of a condensing steam plant.

1. Describe basic equipment and operation of a condensing steam system.
2. Describe installation requirements of a condensing steam system.
3. Describe applicable ASME and other codes.
4. List sources of water and uses of steam.

B. Non-Condensing Steam Plants3 Hours

Outcome: Describe the operation of a non-condensing steam plant.

1. Describe basic equipment and operation of a non-condensing steam system.
2. Describe installation requirements of a non-condensing steam system.
3. Describe applicable ASME and other codes.

C. High Temperature Hot Water Plants3 Hours

Outcome: Describe the operation of steam and hot water plants.

1. Describe basic equipment and operation of a high temperature hot water plant system.
2. Describe installation requirements and uses of high temperature hot water.
3. Describe applicable ASME and other codes.

D. High Pressure Boilers and Accessories6 Hours

Outcome: Describe the operation of high-pressure boilers and accessories.

1. Describe high-pressure boiler types.
2. Describe steam generators.
3. State differences between power, process and heating usage of boilers.
4. Describe the components of a high-pressure steam boiler.
5. Describe how boilers are rated.

E. High Pressure Boiler Trim4 Hours

Outcome: Describe the boiler trim required for operation of high-pressure boilers.

1. Describe trim for a high-pressure steam boiler along with applicable ASME and other codes.
2. Describe installation, operation and location of boiler trim.
3. Describe common service problems and corrective actions associated with boiler trim.

F. High Pressure Boiler Auxiliary Equipment 4 Hours

Outcome: *Describe the auxiliary equipment required for operation of high-pressure boilers.*

1. Describe auxiliary equipment required for high-pressure boilers along with applicable ASME and other codes.
2. Describe installations, operations and functions of auxiliary equipment when not integral to the boiler.
3. Describe common service problems and corrective actions associated with auxiliary equipment.

G. Pressure Vessels 4 Hours

Outcome: *Describe the basic operation of pressure vessels.*

1. Describe pressure vessels for power, process and heating plant applications.
2. Describe differences between fired and unfired pressure vessels including ASME and other code requirements.
3. Describe installation and differences in trim for vessels that are bi-phase (with vapour space) and liquid filled.

H. Power Piping Auxiliary Equipment 3 Hours

Outcome: *Describe the auxiliary equipment required for operation of high-pressure piping systems.*

1. Describe power and heating plant auxiliary equipment, along with ASME and other code requirements.
2. Identify ASME and other codes relative to accessory equipment associated with power and heating plants.
3. Describe the correct piping installation and location of auxiliary equipment for power and heating plants.

I. Power Piping Auxiliary Systems 3 Hours

Outcome: *Describe the operation of power piping auxiliary systems.*

1. Describe the auxiliary systems associated with power and heating plants.
2. Identify ASME and other codes relative to the auxiliary systems associated with power and heating plants.
3. Describe service problems and their solutions associated with power and heating plants.

J. High- Pressure Steam Traps 4 Hours

Outcome: *Describe the operation of high-pressure steam traps.*

1. Describe the classifications of steam traps used for high-pressure installations.
2. Describe the methods for calculating the capacity of a steam trap including factors that may affect its abilities.
3. Describe the correct piping procedure for various steam traps including cooling legs and required trim.
4. Describe methods of checking the operation of high-pressure steam traps.

K. Cascading and Exhaust Steam Systems 4 Hours***Outcome: Describe the operation of cascading and exhaust steam systems.***

1. Describe the operation and application of a cascading steam system including the applicable ASME and other code requirements.
2. Describe the basic component parts and the operational pressures commonly found in a cascading system.
3. Describe the operation and applications of an exhaust steam system including the applicable ASME and other code requirements.
4. Describe the function of the component parts of an exhaust steam system.

L. Pressure Reducing Valve Stations 2 Hours***Outcome: Describe the operation of pressure reducing valve stations.***

1. Describe application and operation of single and double-seated valves when used as series or parallel pressure reducing valve (PRV) stations, including bypass valve types and how their capacity is determined.
2. Identify the ASME code and manufacturer information regarding valve installation requirements, state differences between pressure control and pressure reducing valves, including common maintenance problems and their solutions.

M. Specialty Steam Equipment and Heat Tracing 4 Hours***Outcome: Describe the basic operation of specialty and heat tracing piping systems.***

1. Describe specialty steam equipment including operations.
2. Describe safety practices for the installation and servicing of utility steam piping systems.
3. Describe heat tracing including methods, materials, applications and differences for field installation, built-in and jacketed types.
4. Describe installation procedures including safety practices when installed in power and heating plants.

N. Cooling Towers and Heat Exchangers 4 Hours***Outcome: Describe the operation of cooling towers and heat exchangers.***

1. Describe the difference between calorifiers including safety trim, ASME and other code requirements.
2. Describe the differences of water-to-water and steam-to-steam processes, including how appropriate unit selections are made, common service problems and their solutions.

SECTION FIVE: PRACTICAL APPLICATIONS 48 HOURS**A. Fabrication of Eccentric Reducing Tee 6 Hours*****Outcome: Fabricate and assemble an eccentric reducing tee to specific requirements.***

1. Identify symbols used on spool or piping drawings.
2. Develop the template required for a 3" eccentric tee on a 4" header.

B. Concentric Lateral Y Branch 6 Hours

Outcome: *Fabricate and assemble a concentric Y branch lateral to specific requirements.*

1. Identify tools required for fabrication of a 45° Y lateral branch.
2. Develop the template required for a 3" by 45° lateral Y branch on a 4" pipe.

C. Piping Project 18 Hours

Outcome: *Fabricate and assemble a piping project to specific requirements.*

1. Identify tools required for project.
2. Assemble project to specifications and test as required.

D. True Wye Project 6 Hours

Outcome: *Fabricate and assemble a true wye to specific requirements.*

1. Describe requirements for fabrication and assembly of a true wye.

E. Instrument Tubing Circuit 6 Hours

Outcome: *Fabricate tubing project to specific requirements.*

F. Tour 6 Hours

Outcome: *Observe industry related site.*

SECTION SEVEN: TRADE MATH AND SCIENCE 20 HOURS

A. Trade Math 12 Hours

Outcome: *Solve mathematical problems associated with the Steamfitter-Pipefitter trade.*

1. Calculate volumes of tanks and cylinders (including spherical/hemispherical).
2. Apply and calculate offsets and odd angle mitres using trigonometric functions.
3. Calculate equal/unequal spread offsets.
4. Apply and calculate rolling offsets.

B. Trade Science 8 Hours

Outcome: *Solve science problems associated with the Steamfitter-Pipefitter trade.*

1. State the science of, and solve problems associated with, pressure and flow.
2. State the science of, and solve problems associated with, buoyancy.
3. State the science of, and solve problems associated with, flow of fluids and gases.
4. State the science of, and solve problems associated with, the effects of pressure and vacuum on steam.
5. State the science of, and solve problems associated with, expansion and contraction of pipes.

SECTION EIGHT:BLUEPRINT READING, SKETCHING AND DRAWING 44 HOURS**A. Applied Industrial Blueprint Reading 24 Hours*****Outcome: Read and interpret blueprints and specifications for industrial applications.***

1. Identify steamfitting-pipefitting equipment to be installed.
2. Identify steamfitting-pipefitting piping processes.
3. Interpret symbols and abbreviations.
4. Identify location, type and size of equipment to be installed.
5. Identify piping to be installed.
6. Analyze blueprints for possible service conflicts.
7. Read and interpret blueprints for sectional drawings.
8. Identify specific locations using grid lines and co-ordinates.

B. Orthographics 4 Hours***Outcome: Interpret orthographic readings on drawings using imperial and metric measurements.***

1. Interpret plans in both SI and imperial units.
2. Identify correct location, type, number and size of pieces of equipment and piping to be installed.
3. Using grid lines identify specific locations of piping and equipment.

C. Schematics 6 Hours***Outcome: Interpret and draw piping schematics to specific requirements.***

1. Interpret flow diagrams and schematics with either SI or imperial units.
2. Interpret symbols and lines.
3. Draw piping and instrumentation diagrams.

D. Piping Spools 6 Hours***Outcome: Draw piping spools to specific requirements.***

1. Define piping spools.
2. List and identify fitting symbols.
3. Use proper lettering form.
4. Draw shop project as directed.
5. Compile material list in a sequential manner.

E. Rolling Offsets 4 Hours***Outcome: Draw rolling offsets.***

1. Describe the process for sketching rolling offsets.
2. Sketch a rolling offset from information provided.



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